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(51) INT CL[7]
H01L 33/00

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JP 110298048 A JP 080008463 A JP 030119770 A
US 4935665 A

(58) Field of Search
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INT CL[7] H01L 25/075 25/13 33/00
ONLINE: WPI, EPODOC, PAJ

(54) Abstract Title
A light emitting diode device

(57) A light emitting diode device 1 includes a heat dissipating substrate 11, a light emitting diode chip 12, a printed circuit board 13, a layer of protecting epoxy 14, a lens layer 15 and a positioning layer 16. The heat dissipating substrate 11 is installed at the bottom and a cavity 112 is provided on the upper surface on the heat dissipating substrate 11. A mounting region 111 is installed in the inner surface of the heat dissipating substrate 11 for mounting the light emitting diode chip 12. The heat dissipating substrate 11 can be made of materials, such as aluminum, copper, or other metal or alloy which have good thermal conductivity. The bottom can be formed with a plurality of heat dissipating slots 113 or heat dissipating fins 114. Each light emitting diode chip 12 is connected to the mounting region 111, either directly or via a submount 115. Each printed circuit board 13 is firmly secured to the heat dissipating substrate 11 and is provided with at least one electrode portion 131 and is connected with at least one conductive wire 132 to the light emitting diode chip 12. The chip protecting epoxy layer 14 serves to protect the light emitting diode chip 12. The lens layer 15 is provided over the chip protecting epoxy layer 14 and is formed as a spherical cover or covers of other shapes for adjusting view angle. The positioning layer 16 serves to position the lens layer 15 to the printed circuit board 13. The heat dissipating substrate 11 may have a curved surface, may be of an elongated shape or may have a bent portion. A light visor 20 may be installed in front of the device to reduce the interference of light from the outer environment. The device may be used as a backlight for an LCD, a third braking light for a vehicle, a traffic light or a strip light source.

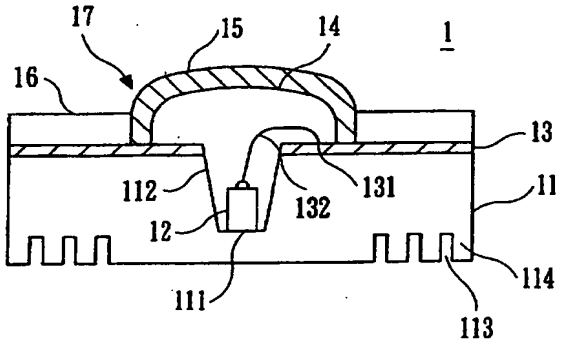

FIG. 2A

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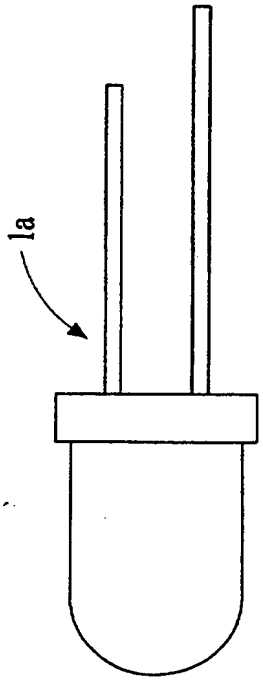

FIG. 1

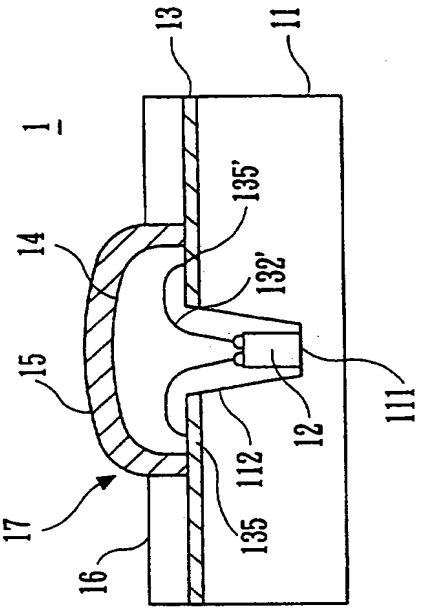

FIG. 2B

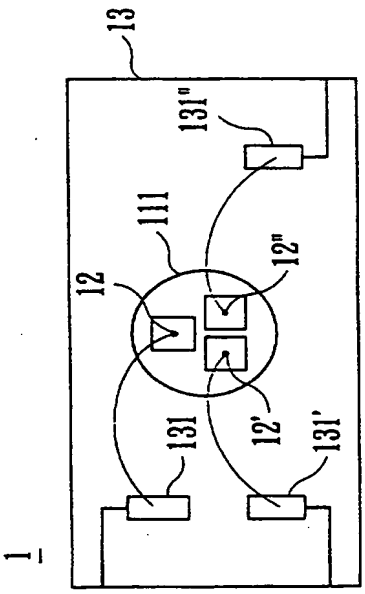

FIG. 2D

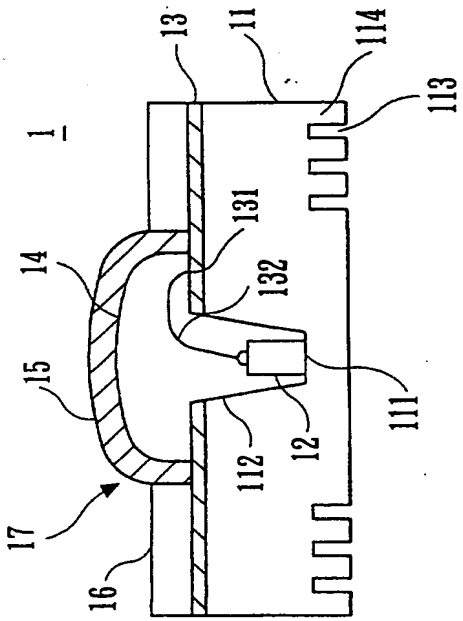

FIG. 2A

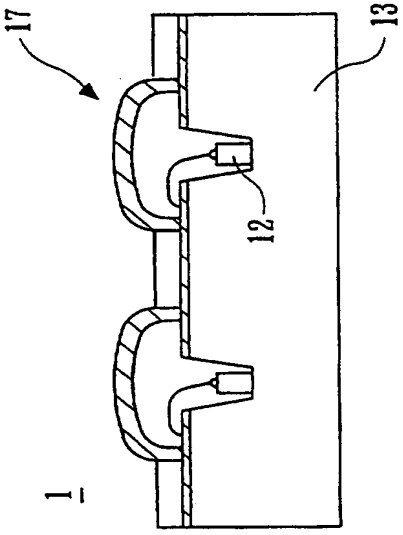

FIG. 2C

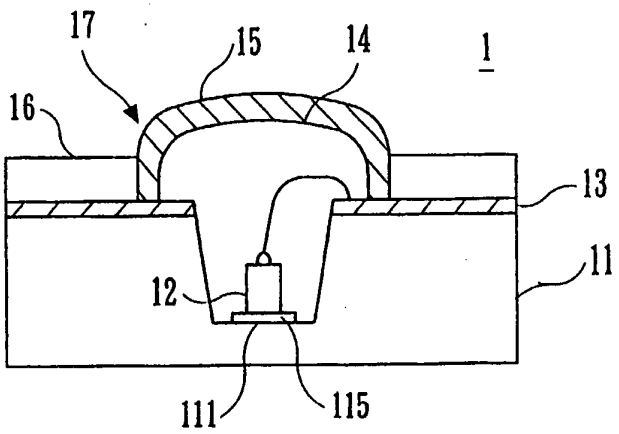

FIG. 2E

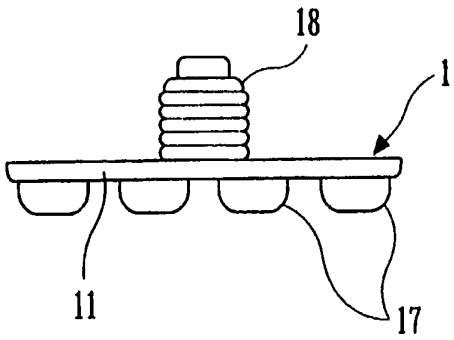

FIG. 3A

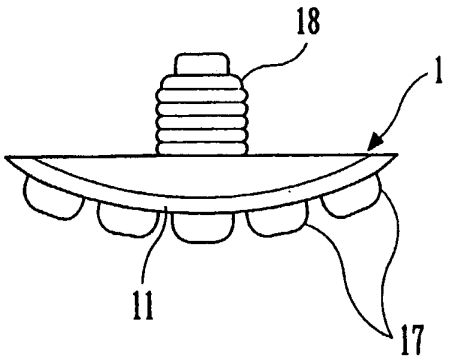

FIG. 3B

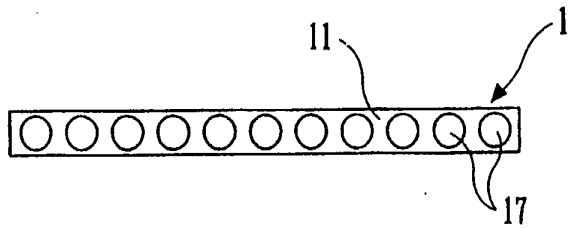

FIG. 3C

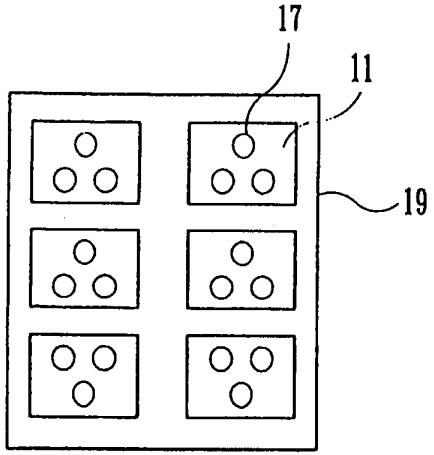

FIG. 3D

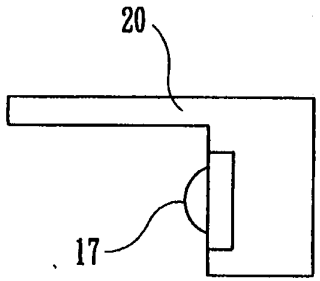

FIG. 3E

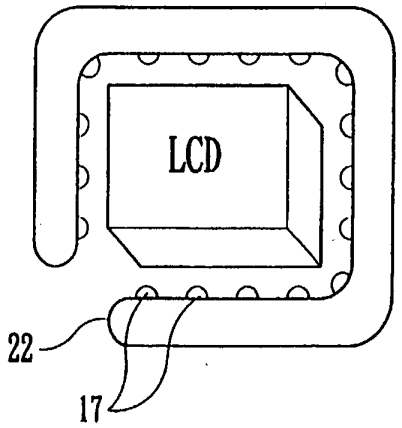

FIG. 3G

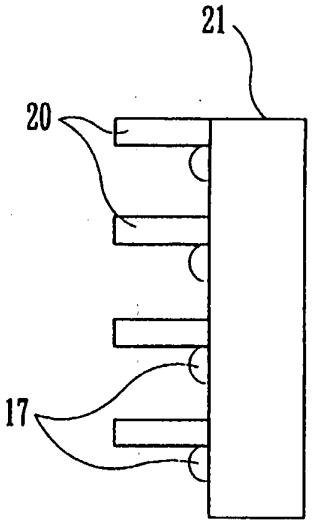

FIG. 3F

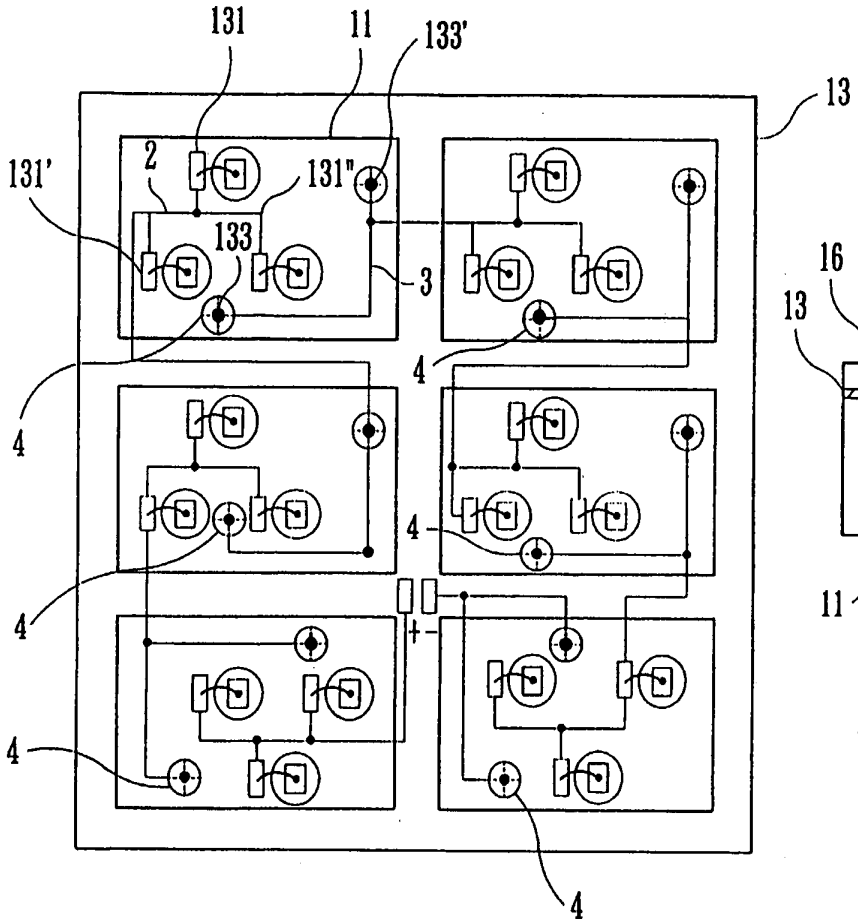
131
11
133'
13
131'
2
131"
133
3
4
4
4
4
4
4

FIG. 4A

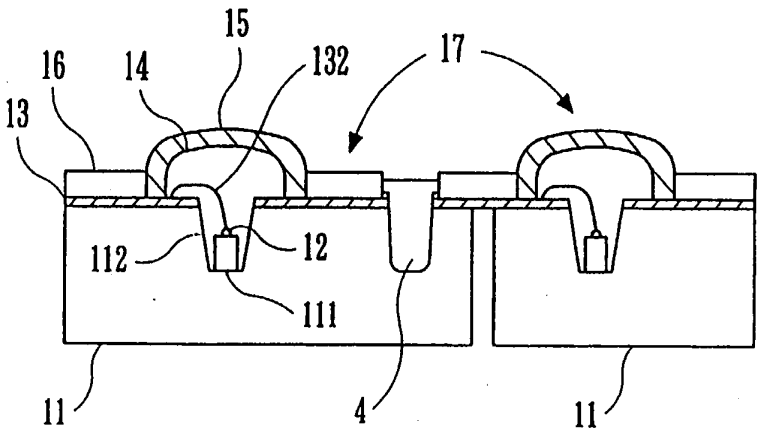
15
16
14
132
17
13
112
12
111
11
4
11

FIG. 4B

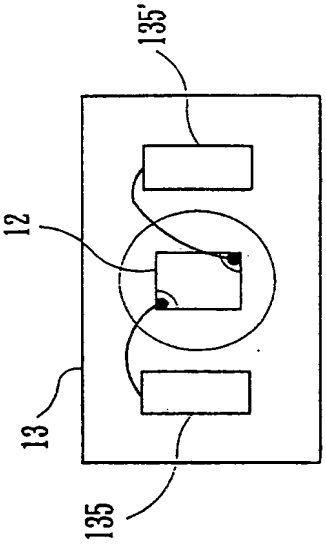

FIG. 5B

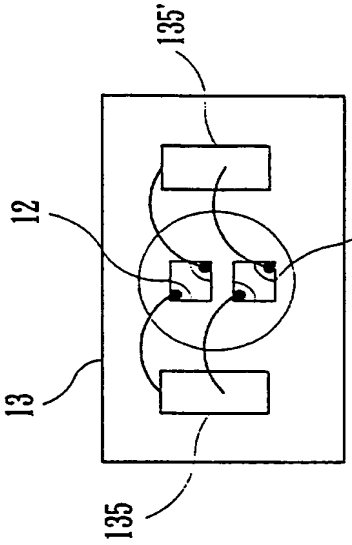

FIG. 5C

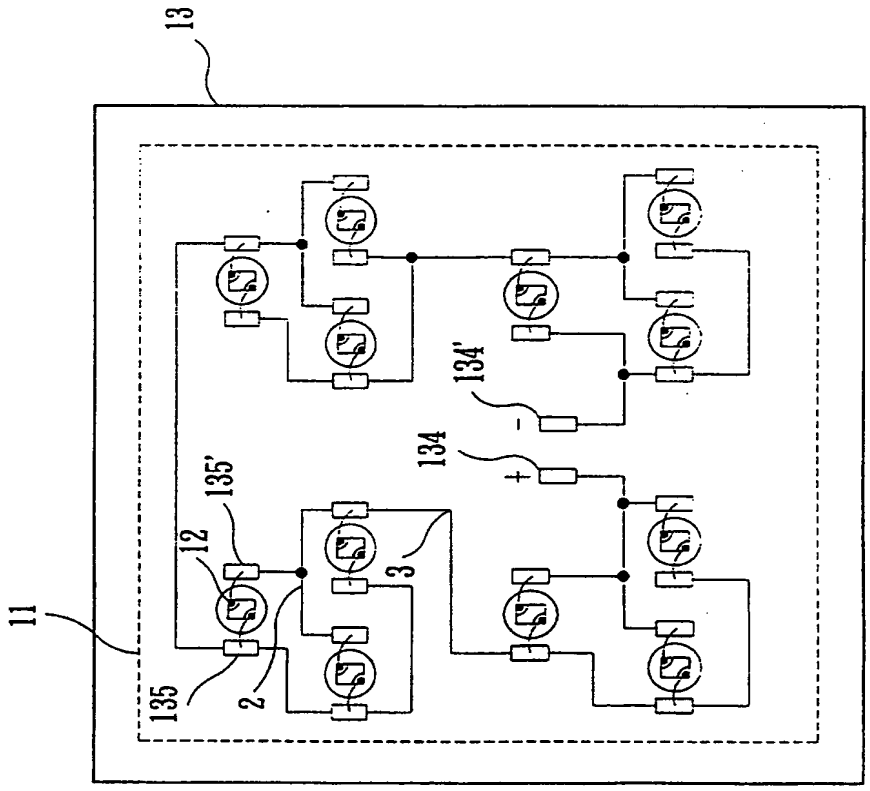

FIG. 5A

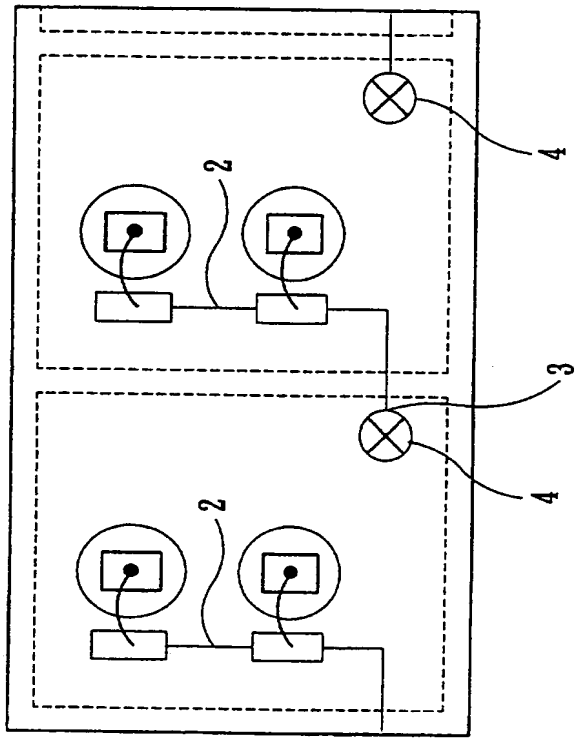

FIG. 6B

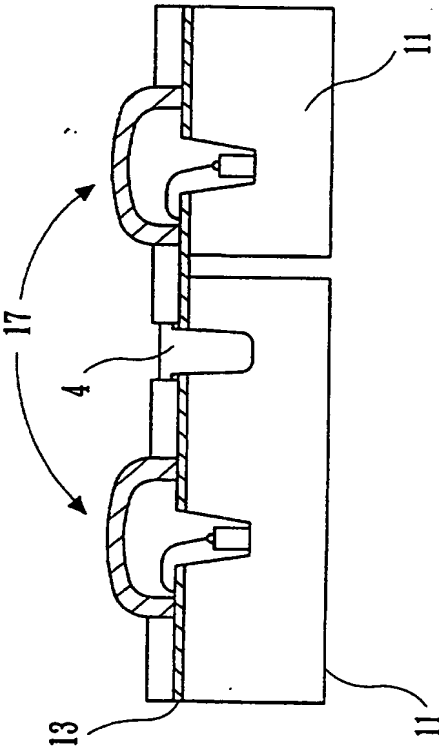

FIG. 6A

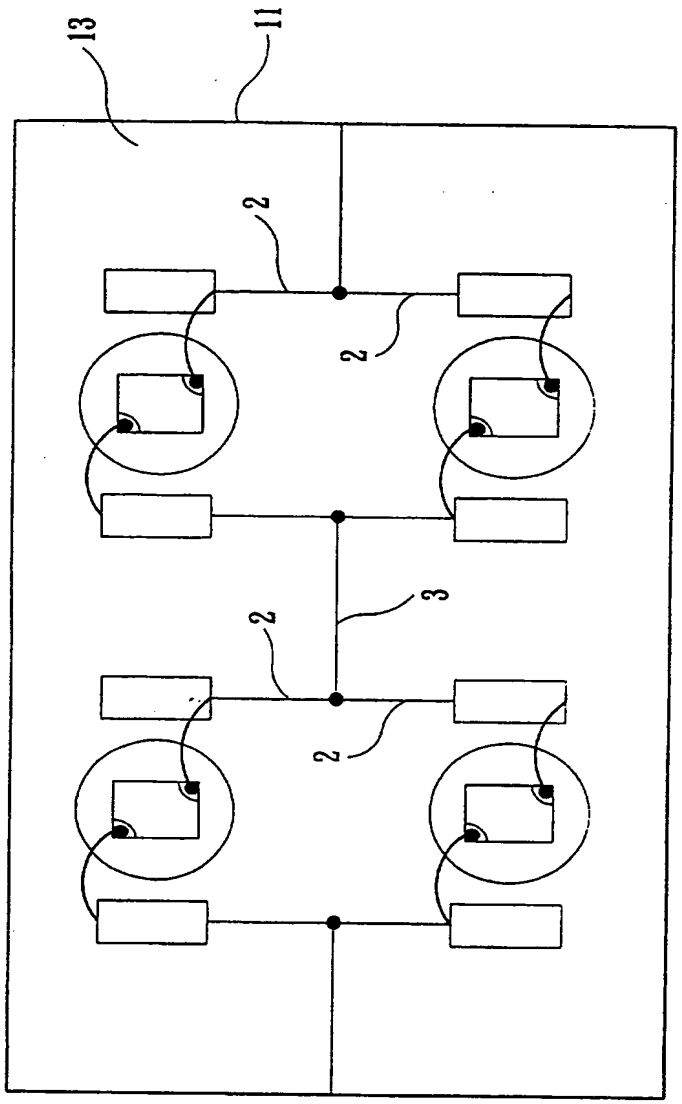

FIG. 7

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LIGHT EMITTING DIODE DEVICE

FIELD OF THE INVENTION

The present invention relates to a light emitting diode device, and especially to a light emitting diode device having a low thermal resistance. The light emitting diode device includes a printed circuit board, a heat dissipation substrate attached to a lower side of the printed circuit board and a plurality of light emitting diode chips mounted on an upper surface of the heat dissipation substrate and electrically connected in parallel and / or in serial so to achieve good heat dissipation ability, high brightness and high density of light emitting diode chips in the same area.

BACKGROUND OF THE INVENTION

As shown in Fig. 1, a plane view of a prior art LED lamp indicator is illustrated. In the LED lamp indicator, because of a too high thermal resistance, the heat within the LED lamp indicator 1a can not be dissipated effectively. Therefore, the light emitting efficiency is reduced with the temperature rising due to increment of current. Moreover, if one LED lamp indicator 1a is not used carefully, it is possible to be destroyed due to heat expansion from a large current. Therefore, a conventional used LED lamp indicator is not suitable to be used in high power device and thus, a novel design is required to improve such defects.

SUMMARY OF THE INVENTION

Accordingly, the primary object of the present invention is to provide a light emitting diode device including a heat dissipating substrate, at least one light emitting diode chip, at least one printed circuit board, at least one layer of protecting epoxy, at least one lens layer and at least one positioning layer. By properly combining the heat dissipating substrate and the printed circuit board thereabove, many different light emitting diode devices are formed for being commercially used. Moreover, by at least one parallel connecting and / or serial connecting wire between the light emitting diode chips, a low thermal resistance light emitting diode device is formed.

The various objects and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plane view of a general used LED lamp indicator.

Fig. 2A is a cross sectional view showing the first preferred embodiment of the present invention.

Fig. 2B is a cross sectional view showing the second preferred embodiment of the present invention.

Fig. 2C is a cross sectional view showing the third preferred embodiment of the present invention.

Fig. 2D is a top view showing the fourth preferred embodiment of the

present invention.

Fig. 2E is a cross sectional view showing another arrangement of the illuminating section in the present invention.

Fig. 3A is a plane view of the fifth preferred embodiment of the present invention.

Fig. 3B is a plane view of the sixth preferred embodiment of the present invention.

Fig. 3C is a plane view of the seventh preferred embodiment of the present invention.

Fig. 3D is a plane view of the eighth preferred embodiment of the present invention.

Fig. 3E is a lateral view of the ninth preferred embodiment of the present invention.

Fig. 3F is a lateral view of the tenth preferred embodiment of the present invention.

Fig. 3G is a perspective view of the eleventh preferred embodiment of the present invention.

Fig. 4A shows an assembled circuit connection of the twelfth preferred embodiment of the present invention.

Fig. 4B is an assembled circuit cross sectional view of the twelfth preferred embodiment of the present invention.

Fig. 5A shows an assembled circuit connection of the thirteenth preferred embodiment of the present invention.

Fig. 5B is a top view showing an assembled circuit of the thirteenth preferred embodiment of the present invention.

Fig. 5C is a top view showing another assembled circuit connection of the thirteenth preferred embodiment of the present invention.

Figs. 6A is a cross sectional view for serial circuit connections of the fourteenth preferred embodiment of the present invention, wherein the heat dissipating substrate is divided.

Figs. 6B is a top view for parallel and serial connections of the fourteenth preferred embodiment of the present invention, wherein the heat dissipating substrate is divided.

Fig. 7 is an upper view for parallel and serial circuit connections of the fifteenth preferred embodiment of the present invention, wherein the heat dissipating substrate is not divided.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Fig. 2A, a cross sectional view of the first preferred embodiment according to the present invention is illustrated. The present invention provides a light emitting diode device (LED device) 1 which includes a heat dissipating substrate 11, at least one light emitting diode chip 12, at least one printed circuit board 13, at least one layer of protecting epoxy 14, at least one lens layer 15 and at least one positioning layer 16. The heat dissipating substrate 11 is installed at bottom of the LED device 1. A cavity 112 is installed on an upper surface of the heat dissipating substrate 11. A mounting region 111 is installed in the inner surface of the cavity 112 for mounting the light emitting diode chip 12. The heat dissipating substrate 11 can be made of aluminum, copper, or other metal and alloy materials which has good thermal conductivity. The bottom can be

formed with a plurality of heat dissipating slots 113 or heat dissipating fins 114. Each light emitting diode chip 12 can be connected to the mounting region 111, or is attached directly to the heat dissipating substrate 11, or as that shown in Fig. 2E, is mounted to a submount 115 on the heat dissipating substrate 11. The submount 115 has the functions of accommodating the expanding coefficients of the light emitting diode chip 12 and the heat dissipating substrate 11 and / or heat dissipation. Each printed circuit board 13 is firmly secured to the heat dissipating substrate 11 and is installed with at least one electrode portion 131 and is connected with at least one conductive wire 132 (aluminum wire or gold wire) to the light emitting diode chip 12. The printed circuit board 13 can be very thin (for example 0.2mm) for reducing the absorption of reflecting and refracting light and thus to enhancing the light emitting effect. The chip protecting epoxy layer 14 serves to protect the light emitting diode chip 12. The lens layer 15 is provided over the chip protecting epoxy layer 14 and is formed as a spherical cover or other shape for adjusting view angle. The positioning layer 16 serves to position the lens layer 15 to the printed circuit board 13. The cavity 112, mounting region 111, printed circuit board 13, light emitting diode chip 12 and conductive wire 132 are formed as an illumination section 17.

As shown in Fig. 2B, the cross sectional view of the second preferred embodiment according to the present invention is illustrated. The difference of the second preferred embodiment diode chip 12 to that in the Fig. 2A is that a left electrode portion 135 and a right electrode portion 135' are installed at the left and right sides of the upper surface of the light emitting

diode chip 12 and are connected to conductive wires 132 and 132', respectively, so as to be connected to the light emitting diode chip 12.

As shown in Fig. 2C, the cross sectional view of third preferred embodiment of the present invention is illustrated. The difference of the third preferred embodiment to the Fig. 2A is that in a light emitting diode chip 12, at least two illumination sections 17 are formed on the heat dissipating substrate 11.

As shown in Fig. 2D, the top view of the fourth preferred embodiment according to the present invention is illustrated. The difference of this embodiment to Fig. 2A is that more than one chips 12, 12' and 12" can be installed in a single illumination section 17, and each chip has a different illuminating color (for example, blue color, red color and green color for different chips) and is connected to a respective conductive wire 132.

As shown in Fig. 3A, a plane view of the fifth preferred embodiment of the present invention is illustrated. The present invention is designed such that the light emitting diode device 1 includes more than one illumination section 17. A base 18 is installed thereon. The illumination section 17 is installed on one plane surface of the heat dissipating substrate 11. The illumination section 17 can be designed to emit a single color, multiple colors, or even a white color. For example, the light emitting diode device 1 including a illumination section 17 can be formed as the head light source of a portable lighting device, such as flash light. The white light of the illuminating section 17 can be generated by using a light emitting diode chip 12 that emits a blue light or an ultra violet light and providing fluorescent agent or agents in the illuminating section 17. When the light

emitting diode chip 12 of the blue light is used, the fluorescent agent(s) that generates yellow light is selected so that the blue light and the yellow light mix to become white light. When the light emitting diode chip 12 of an ultra violet light is used, the fluorescent agents are selected to generate lights that can mix to become white light; for instance, red, green, and blue lights are generated by the fluorescent agents and mix to become white light.

As shown in Fig. 3B, a plane view of the sixth preferred embodiment of the present invention is illustrated. The difference of this embodiment to Fig. 3A is that the illumination section 17 is installed at a sector, a hemispherical section, or a curved surface of the heat dissipating substrate 11. In this embodiment, a plurality of illumination sections 17 are installed at single one heat dissipating substrate 11. In another embodiment, a light apparatus can be formed by a plurality of devices 1.

As shown in Fig. 3C, a plane view of the seventh preferred embodiment of the present invention is illustrated. The difference of this embodiment to Fig. 3A is that the illumination section 17 is installed on an elongated light emitting diode device 1 and can be extended as a strip light source device matching with different horizontal view angles, thus, it can be suitable for the back light source device of a liquid crystal display (LCD) or as a third braking light for a car.

As shown in Fig. 3D, a plane view of the eighth preferred embodiment of the present invention is illustrated. The difference of this embodiment to Fig. 3A is that three illumination sections 17 are installed on a heat dissipating substrate 11 to be formed as a light emitting unit and six units are formed as a light source device 19 for a traffic light.

As shown in Fig. 3E, a lateral view of the ninth preferred embodiment of the present invention is illustrated. The difference of this embodiment to that in Fig. 3A is that a light visor 20 is installed in front of the light emitting diode device 1 with a single illumination section 17 for reducing the interference of light from outer environment.

As shown in Fig. 3F, a plane view of the tenth preferred embodiment of the present invention is illustrated. The difference of this embodiment to that in Fig. 3E is that a light emitting diode cluster (LED cluster) 21 is formed by 16 (4*4) illumination sections 17. The LED cluster 21 can be formed by m * n illumination sections 17, wherein m , n are positive integers, such as 1, 2, 3,...

As shown in Fig. 3G, the perspective view of the eleventh preferred embodiment of the present invention is illustrated. The difference of this embodiment to that in Fig. 3 is that the light emitting diode device 1 can be formed as a light emitting ring 22 with a ring or to have a bent portion in shape for being used as a backlight source device of a liquid crystal display.

As shown in Figs. 4A and 4B, the circuit diagram of the twelfth preferred embodiment of the present invention is illustrated, which is identical to the embodiment shown in Fig. 3D. In the circuit, each of the left and right sides of a single printed circuit board 13 is installed with three identical or different heat dissipation substrate 11. A serial connecting wire 3 is installed to connect each electrode portion 131, 131' and 131". Each end contact portion 133 and 133' can be provided with an electric connecting means 4, such as screwing or welding for connecting the heat dissipating substrate 11 to the printed circuit boards, respectively, 13.

The printed circuit boards 13 are electrically connected by the parallel connected wire 2 so as to form a complete circuit.

As shown in Figs. 5A, 5B and 5C, top views of circuit diagrams of the thirteenth embodiment of the present invention in different arrangement are illustrated. This embodiment is similar to the embodiment shown in Fig. 3D, but only four sets of illumination sections 17 (three in each set) are installed in a single and complete heat dissipating substrate 11 and installed with a whole printed circuit board 13. The light emitting diode chips 12 thereon are connected to the parallel connected circuits 2 and serial connected circuits 3 through a left electrode portion 135 which may be a negative electrode and a right electrode portion 135' which may be positive electrode so as to be formed as an assembled circuit. Further, since the positive and negative electrodes of each light emitting diode chip 12 are installed on the upper surface of the printed circuit 13. The parallel connected circuits 2 and serial connected circuits 3 can be completely determined by the printed circuit board 13. Consequently, the heat dissipating substrate 11 is electrically neutral, it can be made as a whole piece. In Fig. 5B, the illumination section 17 only includes a single light emitting diode chip 12. In Fig. 5C, the illumination section 17 includes a plurality of light emitting diode chips 12 and 12'.

As shown in Figs. 6A and B, the cross sectional view for serial connections and top view of serial and parallel circuit connections of the fourteenth preferred embodiment of the present invention is illustrated, wherein the heat dissipating substrate 11 is divided. A screwed connection portion (or welding portion) can be installed at a proper place on the

printed circuit board 13 to be formed as an electric conductive means 4. Then many pieces of divided heat dissipating substrates 11 are screwedly connected (or welded) to the lower side of the heat dissipating substrate 11. Thus, the heat dissipating substrate not only provides the function of heat dissipation but is also electrically connected to the parallel connected circuits 2 and serial connected circuits 3 on the upper surface of the printed circuit board 13.

As shown in Fig. 7, the top view of serial and parallel connections of the fifteenth preferred embodiment of the present invention is illustrated, wherein the heat dissipating substrate 11 is unnecessary to be divided. The difference of this embodiment to that shown in Figs. 6A and 6B is that the heat dissipating substrate 11 therebelow is unnecessary to be divided and the whole circuit is completed by connecting the chip to all the parallel connected circuits 2 and serial connected circuits 3 on the upper surface of the printed circuit board 13 thereabove. No screwed connection or welding connection is required.

The present invention has the following advantages:

1. With at least one light emitting diode, at least one heat dissipation substrate and at least one printed circuit board properly accommodated, an LED device having very low heat resistance is achieved.
2. With the light emitting diode chips properly connected by parallel and / or serial circuit, an LED device of great commercial value is created.
3. The light emitting diode chip is directly fixed to the heat dissipating

substrate, so that the thermal resistance is reduced greatly. The ability to sustain high current is increased and thus the present invention is especially suitable to be used in a high power consumption device.

4. Since the light emission ability for each chip is greatly enhanced, thus illumination is improved largely in the same area, or only a smaller area is necessary to provide an identical illumination.

Although the present invention has been described with reference to the preferred embodiments, it will be understood that the invention is not limited to the details described thereof. Various substitutions and modifications have been suggested in the foregoing description, and others will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A light emitting diode device comprising:

at least one heat dissipating substrate, provided at a bottom of the light emitting diode device and made of a metal or an alloy;

at least one illuminating section provided on an upper surface of the heat dissipating substrate and comprising:

a cavity being formed on the heat dissipating substrate;

a printed circuit board provided above the printed circuit board;

at least one light emitting diode chip provided in the cavity, said light emitted diode being directly attached to the heat dissipating substrate or to a submount provided between said light emitting diode chip and the heat dissipating substrate; and

at least one conductive wire connected between each light emitting diode chip and the printed circuit board.

2. The light emitting diode device as claimed in claim 1, wherein the illumination section includes at least one chip protecting layer for the light emitting diode chip.

3. The light emitting diode device as claimed in claim 1, wherein the illuminating section includes at least one lens layer provided over the light emitting diode chip for adjusting the view angle of the light emitted from the chip.

4. The light emitting diode device as claimed in claim 1, wherein the bottom of the heat dissipating substrate is directly machined to form heat dissipation means thereon or is further installed with heat

dissipating means.

5. The light emitting diode device as claimed in claim 3, wherein the lens layer is positioned on the heat dissipating substrate by at least one positioning piece.

6. The light emitting diode device as claimed in claim 1, wherein said at least one light emitting diode chip includes a plurality of light emitting diode chips which can emit lights of at least two different colors.

7. The light emitting diode device as claimed in claim 1, wherein said at least one illumination section includes a plurality of illuminating sections emitting lights having at least two different colors.

8. The light emitting diode device as claimed in claim 1, wherein said illumination section is provided on a plane surface of the heat dissipating substrate.

9. The light emitting diode device as claimed in claim 1, wherein said illumination section is provided on a curved surface of the heat dissipating substrate.

10. The light emitting diode device as claimed in claim 1, wherein the heat dissipating substrate is of an elongated shape.

11. The light emitting diode device as claimed in claim 1, wherein the heat dissipating substrate has a bent portion.

12. The light emitting diode device as claimed in claim 1, wherein said at least one illumination section includes a plurality of illumination sections provided on a plurality of heat dissipating substrates.

13. The light emitting diode device as claimed in claim 12, wherein said plurality of heat dissipating substrates are provided below the same

printed circuit board.

14. The light emitting diode device as claimed in claim 1, wherein said at least one light emitting diode chip includes a plurality of light emitting diode chips for emitting blue or ultraviolet light, and the illumination section includes fluorescent agent so as to emit white light.

15. The light emitting diode device as claimed in claim 1, wherein at least one light visor is included.

16. The light emitting diode device as claimed in claim 15, wherein each of said illumination section is provided with a plurality of said light emitting diodes which emit lights having at least two different colors.

17. The light emitting diode device as claimed in claim 15, wherein said at least one illuminating section includes a plurality of illumination sections emitting lights having at least two different colors.

18. A light emitting diode device substantially as hereinbefore described with reference to, and as illustrated in figures 2A to 7 of the accompanying drawings.

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): HIK (KEAX, KPADL)

Int Cl (Ed.7): H01L 25/075, 25/13, 33/00

Other: Online: WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	JP 62-235787 A	(KOITO) Abstract and figures.	1, 5, 8, 10, 14, 16, 17
X	JP 62-229987 A	(KOITO) Abstract and figures.	1-5, 8, 10, 12-14, 16, 17
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